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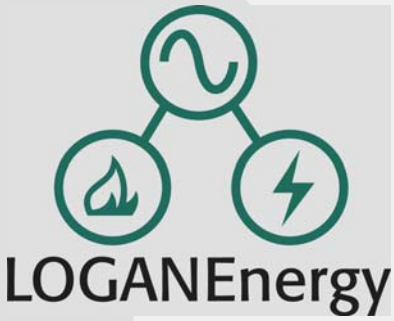

U.S. Army Engineer Research and Development Center,
United States Air Force Academy, Colorado Springs, Colorado
Midpoint Project Report

Proton Exchange Membrane (PEM) Fuel Cell Demonstration Of Domestically Produced PEM Fuel Cells in Military Facilities

US Army Corps of Engineers
Engineer Research and Development Center
Construction Engineering Research Laboratory
Broad Agency Announcement CERL-BAA-FY04

Headquarters:

1080 Holcomb Bridge Rd
Suite 100-175
Roswell, GA 30076
Ph (770) 650-6388

U.S. Air Force Academy,
USAFA, CO 80840

April 4, 2007

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5680 Adobe Road
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Executive Summary

Under terms of its FY'04 DOD PEM Demonstration Contract with ERDC/CERL, at the U.S. Air Force Academy, CO, LOGANEnergy installed one Plug Power GenSys 5kWe Combined Heat and Power fuel cell power plant. The site on the base selected for the one-year demonstration project is the Building 8119, a fitness facility. The unit has been electrically configured to provide grid parallel/grid independent service to the site and it is also thermally integrated with a building domestic hot water system. It is anticipated that the project will reduce annual energy costs to the Academy by $131.04 during the demonstration.

The initial Air Force Academy POC for this project was Thomas Hykes, who may be reached at 719.333.8453, Thomas.hykes@usafa.af.mil. During the initial site visit, Tom introduced the new project POC as Diana L. Dean, P.E., CEM, USAFA Energy Manager (Contractor – J&J Maintenance, Inc.) who can be reached at 719.333.8393, Diana.Dean1.ctr@usafa.af.mil.

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Proposal – Proton Exchange Membrane (PEM) Fuel Cell Demonstration of Domestically Produced Residential PEM Fuel Cells in Military Facilities

1.0 Descriptive Title

United States Air Force Academy PEM Demonstration Project, United States Air Force Academy, Colorado Springs, Colorado

2.0 Name, Address and Related Company Information

LOGANEnergy Corporation

1080 Holcomb Bridge Road
BLDG 100- 175
Roswell, GA 30076
(770) 650- 6388

DUNS 01-562-6211
CAGE Code 09QC3
TIN 58-2292769

LOGANEnergy Corporation is a private Fuel Cell Energy Services company founded in 1994. LOGAN specializes in planning, developing, and maintaining fuel cell projects. In addition, the company works closely with manufacturers to implement their product commercialization strategies. Over the past decade, LOGAN has analyzed hundreds of fuel cell applications. The company has acquired technical skills and expertise by designing, installing and operating over 30 commercial and small-scale fuel cell projects totaling over 7 megawatts of power. These services have been provided to the Department of Defense, fuel cell manufacturers, utilities, and other commercial customers. Presently, LOGAN supports 30 PAFC and PEM fuel cell projects at 21 locations in 12 states, and has agreements to install 22 new projects in the US and the UK over the next 18 months.

3.0 Production Capability of the Manufacturer

Plug Power manufactures a line of PEM fuel cell products at its production facility in Latham, NY. The facility produces three lines of PEM products including the 5kW GenSys5C natural gas unit, the GenSys5P LP Gas unit, and the GenCore 5kW standby power system. The current facility has the capability of manufacturing 10,000 units annually. Plug will support this project by providing remote monitoring, telephonic field support, overnight parts supply, and customer support. These services are intended to enhance the reliability and performance of the unit and achieve the highest possible customer satisfaction. Vincent Cassala is the Plug Power point of contact for this project. His phone number is (518) 782-7700, and his email address is Vincent_cassala@plugpower.com.

4.0 Principal Investigator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

5.0 Authorized Negotiator(s)

Name	Samuel Logan, Jr.	Keith Spitznagel
Title	President	Vice President Market Engagement
Company	Logan Energy Corp.	Logan Energy Corp.
Phone	770.650.6388 x 101	860.210.8050
Fax	770.650.7317	770.650.7317
Email	samlogan@loganenergy.com	kspitznagel@loganenergy.com

6.0 Past Relevant Performance Information

a) Contract: PC25 Fuel Cell Service and Maintenance Contract #X1237022

Merck & Company
Ms. Stephanie Chapman
Merck & Company
Bldg 53 Northside
Linden Ave. Gate
Linden, NJ 07036
(732) 594-1686

Four-year PC25 PM Services Maintenance Agreement.
In November 2002 Merck & Company issued a four-year contract to LOGAN to provide fuel cell service, maintenance and operational support for one PC25C fuel cell installed at their Rahway, NJ plant. During the contract period the power plant has operated at 94% availability.

b) Contract: Plug Power Service and Maintenance Agreement to support one 5kWe GenSys 5C and one 5kWe GenSys 5P PEM power plant at NAS Patuxant River, MD. .

Plug Power
Mr. Scott Wilshire.

968 Albany Shaker Rd.
Latham, NY 12110
(518) 782-7700 ex 1338

c) Contract: A Partners LLC Commercial Fuel Cell Project Design, Installation and 5-year service and maintenance agreement on 600kW UTC PC25 power block.
Contract # A Partners LLC, 12/31/01

Mr. Ron Allison
A Partner LLC
1171 Fulton Mall
Fresno, CA 93721
(559) 233-3262

7.0 Host Facility Information

Congress authorized creation of the Air Force Academy in 1954. Harold E. Talbott, then secretary of the Air Force, appointed a commission to assist him in selecting the permanent site. After traveling 21,000 miles and considering 580 proposed sites in 45 states, the commission recommended three locations. From those, Secretary Talbott selected the site near Colorado Springs. The state of Colorado contributed $1 million toward the purchase of the property.

Figure 1. Aerial View of Air Force Academy

Construction began in 1955. That same year, the first class of 306 men was sworn in at a temporary site at Lowry Air Force Base, Denver. On Aug. 29, 1958, the wing of 1,145 cadets moved to its present site from Denver. Less than a year later the Academy received accreditation. On March 3, 1964, the authorized strength of the Cadet Wing was increased to 4,417 and later reduced to its present number of 4,000. Women entered the Air Force Academy for the first time on June 28, 1976. The first class with women graduated in May 1980.

The headquarters of the United States Air Force Academy is supported by the 10th Air Base Wing. Located at the base of the Rampart Range on 18,500 acres; elevation is 7,163 feet above sea level at the Terrazzo level. Approximately one million visitors come to the Academy annually, including up to 7,000 people per day at the Visitor Center.

Cadets are housed in two dormitories, Vandenberg Hall (1,325 rooms) and Sijan Hall (936 rooms). Fairchild Hall contains classrooms, labs and faculty/staff offices (250 classrooms, 45 science labs, 13 lecture halls). Mitchell Hall dining area covers 1.7 acres; staff serves the entire cadet wing at the same time, in and out in only 25 minutes. The Air Force Academy Cadet Chapel is the 1996 recipient of the prestigious American Institute of Architects' (AIA) Twenty-five Year Award. Arnold Hall houses a 2,900-seat Broadway auditorium, ballroom, conference rooms, restaurant and historical displays. Athletic fields cover 143 acres and include 18 football fields, 13 soccer fields, and 10 flicker ball fields; all encompassing, 2,000 people can participate in sporting events at the same time. Cadet Field House includes the Clune Arena, used for basketball, boxing and public speaking events, and seats 6,000. The Field House also has an indoor track, field area, and a hockey rink which seats 2,602. Cadet gym is five stories tall and contains three basketball arenas, two pools (one Olympic size), 19 racquetball courts, weight rooms, four tennis courts, and offices.

8.0 Fuel Cell Installation

Figure 2. Fuel Cell On Pads at Site

Figure 3. Aesthetic Fence for Fuel Cell

On August 25, 2005, LOGAN representatives met with Thomas Hykes, Diana Dean, and Grazianno Del Col of the Academy to perform a site evaluation for the fuel cell project. As contemplated prior to the visit, the proposed site was building 8119, a fitness facility.

The fuel cell was installed on the grassy area at the rear (south side) of the building, pictured in Figure 2. The building's natural gas service is located nearby on the outside wall. Since the selected fuel cell site is in a historic building section of the Academy, a fence was installed to aesthetically shield the view of the fuel cell from the road, Figure 3. The fencing matches the fencing used around the mechanical equipment located at the adjacent building.

With the fuel cell located relatively close to the building, trenching was minimized. A digging permit was obtained prior to commencement of trenching. Other buried utility lines were known to be in the vicinity. Utility connections, except natural gas, were made in the mechanical room located just inside the building wall near the fuel cell. The natural gas connection was made outside.

9.0 Electrical System

Figure 4. Electrical Connection Panel board

The Plug Power GenSys 5C PEM fuel cell power plant provides both gird parallel and grid independent operating configurations for site power management. This capability is an important milestone in the development of the GenSys5 as it approaches product commercialization. The unit has a power output of 110/120 VAC at 60 Hz, and, when necessary, the voltage can be adjusted to 208vac or 220vac depending upon actual site conditions. At this site the unit has been connected to the facility in a grid parallel configuration dispatching power at 2.5 kW for most of the period of performance. The photo at right shows the electrical service where the fuel cell was electrically coupled to the base utility grid. Selected circuits from the panel were moved to a new sub-panel for circuits to be powered by the fuel cell during a grid outage. A 50 amp circuit breaker for connection of the fuel cell will utilize

the panel slots vacated by the circuits moved to the sub-panel. The electrical closet is conveniently located behind the exterior wall adjacent to the fuel cell pad site.

10.0 Thermal Recovery System

Figure 5. Existing DHW System

LOGAN has integrated the fuel cell with the existing domestic hot water system, seen if Figure 5. The DHW system includes the boiler (shown on the left side of photo), two large tanks (one tank partially visible at right side of photo), and a circulating pump (shown at bottom left). Connection to the DHW system has been arranged so that the fuel cell thermal energy will heat the system as much as possible causing the existing boiler to be operated less.

11.0 Data Acquisition System

LOGAN has installed a Connected Energy Corporation web based SCADA system that provides high-speed access to real time monitoring of the power plant. The schematic drawing seen below describes the architecture of the CEC hardware that supports the project. The system provides a comprehensive data acquisition solution and also incorporates remote control, alarming, notification, and reporting functions. The system will pick up and display a number of fuel cell operating parameters on functional display screens including kWH, cell stack voltage, and water management, as well as external instrumentation inputs including Btus, fuel flow, and thermal loop temperatures. CEC's Operations Control Center in Rochester, New York maintains connectivity by means of a Virtual Private Network that links the fuel cell to the center. CEC WEB enabled SCADA terminal hardware.

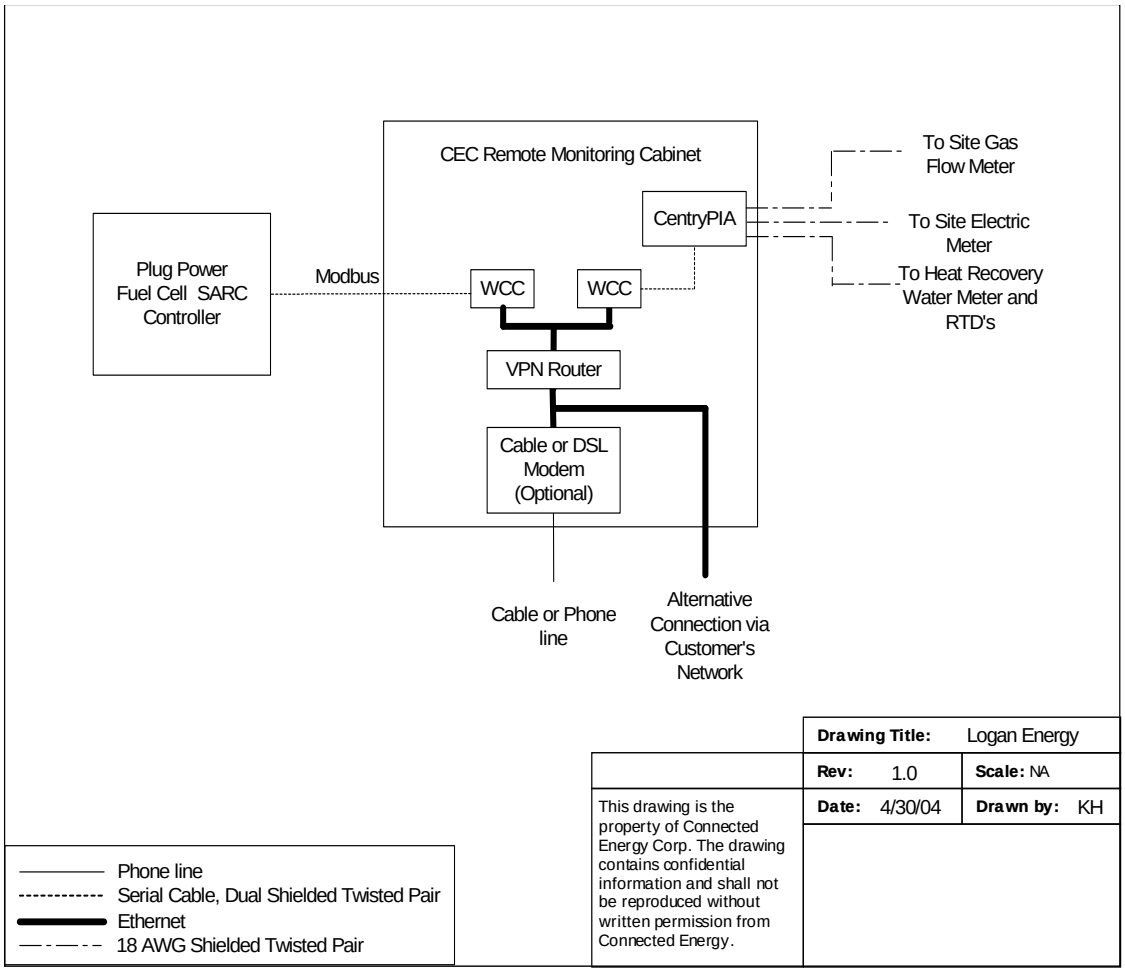

Figure 6. Date Acquisition System Layout

LOGAN procured Internet access to the fuel cell router from a local wireless broadband service provider. The wireless service required placement of a small antenna at the building roofline to receive the signal serving the area around the USAF Academy. The base provides local dial tone to a phone jack conveniently located in the nearby mechanical room to provide communications with the fuel cell data modem.

12.0 Fuel Supply System

A natural gas line serving the building was already available on the exterior of the building, as seen in Figure 7. Connection required only a small amount of trenching from the fuel cell (at right in photo) to the existing gas line (left of mechanical room doors in photo).

Figure 7. Natural Gas Service Location

13.0 Installation Costs

US Air Force Academy, Colorado

Project Utility Rates		
1) Water (per 1,000 gallons)	$	2.94
2) Utility (per KWH)	$	0.051
3) Natural Gas (per MCF)	$	5.09

First Cost	**Budgeted**	**Actual**	**Variance**
Plug Power 5 kW SU-1	$ 65,000.00	$ 65,000.00	$ -
Shipping	$ 2,400.00	$ 2,400.00	$ -
Installation electrical	$ 5,375.00	$ 2,612.00	$ (2,763.00)
Installation mechanical & thermal	$ 7,000.00	$ 3,437.00	$ (3,563.00)
Watt Meter, Instrumentation, Web Package	$ 11,090.00	$ 11,543.00	$ 453.00
Site Prep, labor materials	$ 825.00	$ 1,200.00	$ 375.00
Technical Supervision/Start-up	$ 2,500.00	$ 2,627.00	$ 127.00
Total	**$ 94,190.00**	**$ 88,819.00**	**$ (5,371.00)**
Assume Five Year Simple Payback	$ 18,838.00	$ 17,763.80	

Forcast Operating Expenses	Volume	$/Hr	$/ Yr	
Natural Gas Mcf/ hr @ 2.5kW	0.0330	$ 0.17	$ 1,324.28	
Water Gallons per Year	14,016		$ 41.21	
Total Annual Operating Cost				$ 1,365.48

Economic Summary			
Forcast Annual kWH		19710	
Annual Cost of Operating Power Plant	$	0.069	kWH
Credit Annual Thermal Recovery Rate	$	(0.012)	kWH
Project Net Operating Cost	$	0.0576	kWH
Displaced Utility cost	$	0.0510	kWH
Energy Savings (Cost)		($0.007)	kWH
Annual Energy Savings (Cost)		($131.80)	

Explanation of Calculations:

Actual First Cost Total is a *sum* of all the listed first cost components.

Assumed Five Year Simple Payback is the Estimated First Cost Total *divided by* 5 years.

Forecast Operating Expenses:

Natural gas usage in a fuel cell system set at 2.5 kW will consume 0.033 Mcf per hour. The cost per hour of $0.17 is 0.033 Mcf per hour *x* the cost of natural gas to the USAFA per Mcf at *$5.09*. The cost per year at $1,324.28 is the cost per hour at $0.17 *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.

Natural gas fuel cell systems set at 2.5 kW will consume 1.6 gallons of water per hour through the DI panel. The total volume of water consumed at 14,016 gallons per year is 1.6 gph *x* 8760 hours per year. The cost per year at $41.21 is 14,016 gph *x* cost of water to the USAFA at *$2.94* per 1000 gallons.

The Total Annual Operating Cost, $1,365.48 is the *sum of* the cost per year for the natural gas and the cost per year for the water consumption.

Economic Summary:

The Forecast Annual kWh at 19,710 kWh is the product of 2.5 kW set-point for the fuel cell system *x* 8760 hours per year *x* 0.9. The 0.9 is for 90% availability.
The Annual Cost of Operating the Power Plant at $0.069 per kWH is the Total Annual Operating Cost at $1,365.48 *divided by* the forecast annual kWh at 19,710 kWh.
The Credit Annual Thermal Recovery at -$0.012 is 22,000 BTU per hour of thermal recovery capacity by the fuel cell set at 2.5 kW *x* 8760 hours from twelve months of hot water heater operation *x* a load factor of 0.1 *divided by* 92,000 BTU per Mcf provided by the gas. This equals 209.47 per Mcf of natural gas. *Multiply* this number by the cost of Natural gas at $0.58, and *divide* that product by the total kWh of 19,710. As a credit to the cost summary, the value is expressed as a negative number.
The Project Net Operating Cost is the *sum* of the Annual Cost of Operating the Power Plant *plus* the Credit Annual Thermal Recovery.
The Displaced Utility Cost is the cost of electricity to Barksdale per kWh.

Energy Savings (cost) equals the Displaced Utility Cost *minus* the Project Net Operating Cost.

Annual Energy Savings (cost) equals the Energy Savings *x* the Forecast Annual kWh.

14.0 Acceptance Test

A LOGAN technician, following the completion of all the commissioning tasks listed in the checklist, ran an 8-hour acceptance test on February 24, 2006. It was the first successful start-up of the system. Please see Appendix Section 2 for the checklist used by the technician.

Appendix

1) Monthly Performance Data

Month	Run Time (Hours)	Time in Period (Hours)	Availability (%)	Energy Produced (kWe-hrs AC)	Avg Output (kW)	Fuel Usage (SCF)	Electrical Efficiency (%)
Feb-06	92	168	55%	214.8	2.32	38	24.1%
Mar-06	586	744	79%	1442.7	2.46	242	25.3%
Apr-06	720	720	100%	1852.0	2.57	313	25.1%
May-06	744	744	100%	1868.4	2.51	318	24.9%
Jun-06	720	720	100%	1850.5	2.57	332	23.7%
Jul-06	744	744	100%	1852.0	2.49	359	21.9%
Aug-06	744	744	100%	1862.6	2.50	384	20.6%
Sep-06	720	720	100%	1803.3	2.50	390	19.7%
Oct-06	731	744	98%	1663.0	2.27	318	22.2%
Nov-06	706	720	98%	1752.9	2.48	306	24.3%
Dec-06	677	744	91%	1690.7	2.50	307	23.4%

Running Totals

	Total Run Time	Total Hours in Period	Total Availibility	Total Energy Produced	Total Avg Output	Total Fuel Usage	Average Electrical Efficiency
	7184	7512	96%	17853	2.48	3307	22.9%

2) Documentation of Acceptance Test.

Form used to qualify the fuel cell for initial start and the project acceptance test. Field technician was Warren Hart (WH). Acceptance was completed 24 Feb 2006.

Installation/Acceptance Test Report

Site: U.S. Air Force Academy, CO

Installation Check List

TASK	Initials
Batteries Installed	WH
Stack Installed	WH
Stack Coolant Installed	WH
Air Purged from Stack Coolant	WH
Radiator Coolant Installed	WH
Air Purged from Radiator Coolant	WH
J3 Cable Installed	WH
J3 Cable Wiring Tested	WH
Inverter Power Cable Installed	WH
Inverter Power Polarity Correct	WH
RS 232 /Modem Cable Installed	WH
DI Solenoid Cable Installed with Diode	WH
Natural Gas Pipe Installed	WH
DI Water / Heat Trace Installed	WH
Drain Tubing Installed	WH

Commissioning Check List and Acceptance Test

TASK	Initials
Controls Powered Up and Communication OK	WH
SARC Name Correct	WH
Start-Up Initiated	WH
Coolant Leak Checked	WH
Flammable Gas Leak Checked	WH
Data Logging to Central Computer	WH
System Run for 8 Hours with No Failures	WH

3) Maintenance/Incident Log

[redacted] **Incident Report/Work Log** **US Air Force Academy**

Report Date:	6/21/06	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280
Event:	FUEL CELL AREA GROUNDS MAINTENANCE				
Total Hours On-Site:	8				
Mileage:	120				
Type of Outage:	☑ Scheduled ☐ Unscheduled				
Failure Date/Time:	N/A				
Restart Date/Time:	N/A				
Total Hours Unavailable:	#VALUE!				

Meter Readings:

Gas	
Electric	
BTU	
FC Operating Hours	

Problem Description:
FUEL CELL AREA GROUND SETTLING IN AREAS WHERE FC LINES BURIED IN TRENCH, ALSO GRASS NEEDS TO BE ADDED.

Service Performed or Corrective Action Taken:
FILLED IN TRENCH AREAS WITH TOPSOIL AND RE-SODDED AREAS OVER TRENCH. MATERIAL FREE FROM USAFA COMPOST AREA.
FUEL CELL REMAINS RUNNING FINE.

Report Date:	10/26/06	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280
Event:	SHUTDOWN - HARDWARE ESTOP				
Total Hours On-Site:	2				
Mileage:	80				
Type of Outage:	☐ Scheduled ☑ Unscheduled				
Failure Date/Time:	10/26/06 9:40				
Restart Date/Time:	10/26/06 20:40				
Total Hours Unavailable:	10				

Meter Readings:

Gas	294,554
Electric	31,965.4
BTU	
FC Operating Hours	3562

Problem Description: **SHUTDOWN - HARDWARE E-STOP**
HEAVY WIND IN AREA APPEARS TO HAVE CAUSED CABINET PRESSURE SWITCH FS7_PRES2 TO E-STOP MACHINE.

Service Performed or Corrective Action Taken: RESTART
RESTARTED UNIT, UNIT RUNNING FINE. CALLED UP UNIT SEVERAL TIMES (LAST 10/30/06) ALL WELL.

Report Date:	10/16/06	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280
Event:	STACK CHANGEOUT, 12K HRS MAINTENANCE, ALTITUDE SOFTWARE UPGRADE				
Total Hours On-Site:	12				
Mileage:	120				
Type of Outage:	☑ Scheduled ☐ Unscheduled				
Failure Date/Time:	10/16/06 7:00				
Restart Date/Time:	10/16/06 19:00				
Total Hours Unavailable:	12				

Meter Readings:

Gas	284,298
Electric	31,395.5
BTU	
FC Operating Hours	3334

Problem Description: **STACK,DESULPH,E-WHEEL CHANGEOUT PER PLUG POWER RECOMMENDATION (STACK APPEARS WEAK)**
ALSO UPGRADE SOFTWARE TO NEW ALTITUDE SOFTWARE TAILORED TO HIGH SITE ELEVATION

Service Performed or Corrective Action Taken: REPLACED STACK, DESULPH CANISTER,E-WHEEL, DE-ION WTR FILTER, ENCLOSURE FILTERS. INSTALLED NEW HIGH ALTITUDE SOFTWARE DESIGNED FOR B280, REPLACED THERMINOL AND RE-STARTED UNIT

Report Date:	12/1/06	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280

Event: HEAVY WIND IN AREA APPEARS TO HAVE CAUSED CABINET PRESSURE SWITCH FS7_PRES2 TO E-STOP MACHINE.
Total Hours On-Site: 4
Mileage: 120
Type of Outage: ☐ Scheduled ☑ Unscheduled

Failure Date/Time: 11/30/06 8:40
Restart Date/Time: 12/1/06 18:40
Total Hours Unavailable: 34

Meter Readings:

Gas	332,049
Electric	34,060
BTU	
FC Operating Hours	4400 SYS; 1057 STK

Problem Description: **SHUTDOWN - HARDWARE E-STOP**
HEAVY WIND IN AREA APPEARS TO HAVE CAUSED CABINET PRESSURE SWITCH FS7_PRES2 TO E-STOP MACHINE.
AREA HIT WITH HIGH WINDS AND EXTREME COLD.

Service Performed or Corrective Action Taken: RESTART
CHECKED MAKEUP WATER SYSTEM AND WATER LINE HEATER, ALL OK. THAWED OUT FROZEN FLOAT VALVE ASSM. IN BOTTOM OF ENC.
INSURED BACKUP CABINET HEATER WAS WORKING. CYCLED POWER AND RESTARTED. CHECKED THAT UNIT WAS ONLINE BEFORE HEADING
HOME. CALLED UP UNIT SEVERAL TIMES SINCE. ALL OK.

Report Date:	12/22/06	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280

Event: HEAVY WIND IN AREA APPEARS TO HAVE CAUSED CABINET PRESSURE SWITCH FS7_PRES2 TO E-STOP MACHINE.
Total Hours On-Site: 4
Mileage: 120
Type of Outage: ☐ Scheduled ☑ Unscheduled

Failure Date/Time: 12/20/06 11:14
Restart Date/Time: 12/22/06 17:14
Total Hours Unavailable: 54

Meter Readings:

Gas	
Electric	
BTU	
FC Operating Hours	

Problem Description: **SHUTDOWN - HARDWARE E-STOP**
HEAVY WIND IN AREA APPEARS TO HAVE CAUSED CABINET PRESSURE SWITCH FS7_PRES2 TO E-STOP MACHINE.
AREA HIT WITH HIGH WINDS, EXTREME COLD AND HEAVY SNOW.

Service Performed or Corrective Action Taken: RESTART
CHECKED MAKEUP WATER SYSTEM AND WATER LINE HEATER, ALL OK. THAWED OUT FROZEN FLOAT VALVE ASSM. IN BOTTOM OF ENC.
INSURED BACKUP CABINET HEATER WAS WORKING. CYCLED POWER AND RESTARTED. CHECKED THAT UNIT WAS ONLINE BEFORE HEADING
HOME. CALLED UP UNIT SEVERAL TIMES SINCE. ALL OK.

Report Date:	1/19/07	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280

Event: E-STOP HUMIDIFIER LOW, CAUSED BY RUPTURED WATER MAIN AT USAFA
Total Hours On-Site: 4
Mileage: 120
Type of Outage: ☐ Scheduled ☑ Unscheduled

Failure Date/Time: 1/18/07 12:23
Restart Date/Time: 1/19/07 15:23
Total Hours Unavailable: 27

Meter Readings:

Gas	384,864
Electric	36,847
BTU	
FC Operating Hours	5514 SYS; 2160 STK

Problem Description: **LOSS OF MAKEUP WATER DUE TO WATER MAIN RUPTURE SUPPLYING ALL BUILDINGS IN AREA**
UNIT ESTOPPED DUE TO LOW HUMIDIFIER LEVEL WITH NO MAKEUP WATER SUPPLY

Service Performed or Corrective Action Taken: HUMIDIFIER SUPPLY LINES AND HUMIDIFIER PUMP FROZEN - THAWED WITH
HAIR DRYER. REPOSITIONED AUTOMATIC SUPPLEMENTARY HEATER IN AREA OF HUMIDIFIER TO PREVENT FREEZING IN FUTURE.
CYCLED POWER, CHECKED WATER FLOW (VERY GOOD), CHANGED OUT LEAKING POLISHING FILTER 0-RINGS, STARTED UNIT,
OUTPUTTING KW'S AT 3:20 PM.

Report Date:	1/24/07	**Technician Initials:**	WH	**FC Serial #:**	SU1 B280

Event: HARMONICS TESTING, ASSIST POC IN FUEL CELL TRAINING PICTURE AND MATERIAL GATHERING
Total Hours On-Site: 6
Mileage: 120
Type of Outage: ☐ Scheduled ☐ Unscheduled
Failure Date/Time: 1/24/07 12:00
Restart Date/Time: 1/24/07 12:00
Total Hours Unavailable: 0

Meter Readings:

Gas	
Electric	
BTU	
FC Operating Hours	5634 SYS; 2280 STK

Problem Description: **OBTAIN HARMONICS READINGS FOR REPORTING PURPOSES; OBTAIN PICTURES AND FUEL CELL INSTRUCTIONAL** MATERIAL FOR FUTURE FUEL CELL TRAINING AT USAFA

Service Performed or Corrective Action Taken: TOOK HARMONICS READINGS, INITIAL OBSERVATION IS THAT THE SITE BUILDINGS (HEALTH & WELLNESS CENTER & GYM) POWER SYSTEM APPEARS TO HAVE HIGH TRIPLEN HARMONICS READINGS ON THEIR POWER SYS. THIS IS NOT A RESULT OF THE FUEL CELLS CONNECTION OR OUTPUT TO THE SYSTEM. ALSO REMOVED PANELS FOR POC PICTURES OF FUEL CELL INTERIOR AND DISCUSSED TRAINING MATERIALS FOR FUTURE CLASS.

Report Date:	2/6/07	**Technician Initials:**	WEH	**FC Serial #:**	SU1 B280

Event: HARMONICS TESTING, RETURN VISIT TO TAKE SECOND SET OF READINGS, FIRST READINGS FLAWED
Total Hours On-Site: 3
Mileage: 120
Type of Outage: ☑ Scheduled ☐ Unscheduled
Failure Date/Time: 2/6/07 12:00
Restart Date/Time: 2/6/07 12:00
Total Hours Unavailable: 0

Meter Readings:

Gas	
Electric	
BTU	
FC Operating Hours	5931 SYS; 2578 STK

Problem Description: **OBTAIN SECOND SET OF HARMONICS READINGS FOR REPORTING PURPOSES** FIRST SET OF READINGS WERE FLAWED SHOWING ABNORMALLY HIGH TOTAL HARMONIC DISTORTION. TESTED AND ADJUSTED HARMONICS TESTER, SECOND SET OF READINGS ACCURATE.

Service Performed or Corrective Action Taken: OPERATED FUEL CELL AT 5KW, TOOK HARMONICS READINGS, REDUCED FUEL CELL OUTPUT TO 2.5KW.